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3.32   Fire Enable/Disable Functional Element Sensitivity

Unlike other subsystems of *RADGUNS*, gun firing does not occur every scan. Subroutine FIRCON, which is called every scan, synchronizes the firing of the guns with the rest of the simulation.

After the radar system has been in autotrack mode for a few seconds, the fire-control computer calculates the aim coordinates for the gun and determines if the target is within range. The gun is moved to the aim coordinates by the gun servos. When the target is within tactical range, the fire-control computer turns on the fire light and bursts are simulated by subroutine SHOOT. Each burst must be followed by a short rest to cool the gun barrels. SHOOT keeps track of the fire light and the gun to determine the proper action for the gun to take on the current scan of the radar.

Data Items Required

Data Item		Accuracy	Sample Rate	Comments
8.3.1	Tracking range	± 5 m	10 Hz	AKA reported range.
8.3.2	Fire enable/disable time	± 0.5 s	SV/T	

3.32.1 Objectives and Procedures

FCC fire enable/disable is sensitive to target position and velocity, as well as to tracking error variables that would affect FCC outputs. The method for parametric sensitivity of this FE was to exercise *RADGUNS* for the following conditions:

a.	Model mode:	SNGL/RADR/LLL
b.	Target altitude:	200 m
c.	Target speed:	50 and 150 m/s
d.	Flight path:	LINEAR, at 0, 500 and 1000 m offsets
e.	Radar type:	RAD1
f.	Guns:	Enabled
g.	Output:	Target range at fire enable/disable

Multiple *RADGUNS* runs were made at two different airspeeds and three offset distances to determine the operational performance parameters of the fire enable ("Fire Light On") and disable ("Fire Light Off") functions. Table 3.32-1 describes run simulation procedures in matrix form for the various conditions.

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TABLE 3.32-1. Run Simulation Procedures.

Velocities (m/s)	Offsets (meters)	Events	Measurements
50, 150	0, 500, 1000	Ingress, Break Lock, Reacquire, Egress	Range (meters) at Fire Light On and Off

All simulations were conducted under the conditions listed in Table 3.32-2 below:

TABLE 3.32-2. Simulation Conditions.

Element	Status
Search Radar	Perfect Cuing
MTI	Off
FCC Model	First Order
Clutter	Disabled
Multipath	None
Terrain (Hills)	None
Countermeasures (Jamming)	None

3.32.2 Results

No cases were observed where "Commence Firing" was allowed without the "Fire Light On" condition being met. Likewise, no firing occurred after "Fire Light Off" unless the "On" condition was met again. Table 3.32-3 lists the raw data results of the simulation runs performed to analyze variance of the Fire Enable/Disable function. Velocities are measured in m/s; all other table entries are ranges in meters.

TABLE 3.32-3. Fire Light On/Off Ranges from Simulation Runs.

Velocity	Offset	Light On	Light Off	Break Lock	Reacquire
50	0	2760	**	200	-378
150	0	3312	**	223	-969
50	500	2745	-2216	*	*
150	500	3261	-1630	*	*
50	1000	2748	-2250	*	*
150	1000	3101	-1470	*	*

* No break lock occurred.

**Fire Light Off not observed.

For the "Fire Light On" case (Table 3.32-4), changing the velocity by 100 m/s (from 50 to 150 m/s, or 300%) yielded the following results, by offset:

TABLE 3.32-4. Change in Fire Light On Distance by Offset.

Offset (m)	Change in Fire Light On Distance (m)	% of Change
0	552	20
500	516	19
1000	353	13

A similar comparison for the "Fire Light On" cases (Table 3.32-5) indicates:

TABLE 3.32-5. Change in Fire Light Off Distance by Offset.

Offset (m)	Change in Fire Light Off Distance (m)	% of Change
500	586	26
1000	780	35

In the case of break lock, Table 3.32-6 summarizes reacquisition simulation as it relates to Fire Disable/Enable:

TABLE 3.32-6. Break Lock and Reacquisition Distance Related to Fire Disable/Enable.

% of Velocity Change	Break Lock and Reacquisition Distance (m)	% Increase in Reacquisition Distance
300	614	106

Investigation of the gun barrel cooling function showed that at an "M" setting (for medium) produced approximately 1.3 s cooling intervals. This short duration would require time measurements on the order of 100 to 200 ms. However, the gun barrel cooling function is considered to be less critical than the in-range and break lock conditions, and therefore does not warrant an order of magnitude increase in timing resolution (and corresponding order of magnitude increase in data volume).

3.32.3 Conclusions

This analysis has concluded that Fire Enable/Disable is only mildly sensitive to changes in target velocity and range.